



Guide to Water Quality for Water Main Construction

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1. Purpose

The purpose of this procedure is to ensure that all new Sydney Water potable water mains are introduced into service in a manner consistent with Sydney Water's commitment to public health through the provision of safe drinking water.

This procedure covers the requirements for the capping, swabbing, flushing and testing of new water mains prior to disinfection/commissioning as well as the materials used for disinfection of fittings, and for the swabbing of mains.

This procedure is applicable for all approved water main laying methodologies covering both drinking and recycled water mains. The process also ensures that auditable documentation and records are available confirming that the quality assurance steps of capping, swabbing, flushing and testing are undertaken.

2. Scope

This procedure will guide an authorised person/contractor/constructor or business in meeting the requirements to prepare a water main for disinfection using one of two available options. Options include a combination of capping, swabbing, flushing and testing.

- Option 1: Capping and flushing with turbidity and odour checks.
- Option 2: Capping, swabbing and flushing with clarity and odour checks.

3. Procedure in detail

Sydney Water requires all new water mains to be laid in accordance with one of the two options detailed below in preparation for disinfection. The Water Supply Code of Australia, Sydney Water Edition 2014 (sections 15.1.1 to 15.1.4 - Installation of Pipes and Section 18 - Swabbing) shall also be referred to in conjunction with these options (refer to Appendix 1, Figure 1 - Workflow for a process flow chart).

All contractors are to develop and implement a Safe Work Method Statement (SWMS) to cover the risks identified in this procedure. All contractors must develop Inspection and Test Plans (ITPs) that cover the risks and requirements detailed in this document.

3.1 Option 1 – Capping of pipes and fittings

Table 1 - Option 1

Task no.	Work instruction details	Responsibility
1	All pipes shall be cleaned/capped from the manufacturer or supplier's premises before being received onsite (discussions with WSAA, PIPA and the suppliers are ongoing to confirm capping for larger mains). If pipes are delivered without caps then all pipes should be inspected and cleaned as outlined in step 5 and 6 in this document before installation .	Supplier/ Constructor
2	During and after pipelaying operations , the contractor shall supply and use caps to seal all open ends of pipes, fittings, and valves to prevent contamination . For mains without caps alternative seals may be used providing the seal is clean, non-porous, and drinking water safe. These seals shall be completely removed prior to commissioning, and all caps/seals must be accounted for prior to commissioning. Soft sponges shall not be used to seal pipes, valves or other fittings.	Constructor
3	At the end of each day pipes and fittings in excavations shall be sealed using caps to prevent water or contaminants entering the pipe. When recommencing works any water is to be removed from the trench prior to the removal of caps.	Constructor
4	Caps/seals shall remain in place during boring to prevent contamination.	Constructor
5	Each pipe shall be visually inspected for contaminants prior to laying. Wipe and remove any material prior to installation (Pipe Sanitiser Solution).	Constructor
6	All main taps, fittings and pipe connections shall be sprayed with 1% sodium hypochlorite solution (Pipe Sanitiser Solution).	Constructor
7	Remove 'coupons' from hole saws after each drill. Only hole saws are to be used on water main pipes. Speed bores shall not be used on any water main for any purpose as debris clogs services, valves and hydrants.	Constructor
8	In preparation for flushing and disinfection, each end of laid pipe shall have flushing bends installed. Larger mains to be tapered down to accommodate flushing bends (currently available up to 150mm) or temporary tees installed at the ends of the main. Where flushing bends are attached to blank flanges, the flushing bend should be positioned at the bottom of the flange to facilitate flushing of sediment.	Constructor
9	Flush main for a minimum of 15 minutes or until clear . If water is not clear within 30 minutes check feedwater. If feedwater is not clear contact Sydney Water staff. If feedwater is clear the main must be swabbed as many times as necessary until the water exiting the new main is clear . Ensure that the swab is not damaged and that no material from a damaged swab remains in the main.	Constructor
10	A turbidity and odour test shall be undertaken by a Sydney Water listed Field Tester.	Constructor/ Sydney Water listed Field Tester
11	Hydrostatic (pressure) testing shall be undertaken by a Sydney Water listed Field Tester.	Constructor/ Sydney Water listed Field Tester
12	If acceptance criteria are met the main is ready for disinfection.	Constructor/ Sydney Water

It is the responsibility of the constructor to ensure that mains are laid in accordance with this procedure. If any of the acceptance criteria fails (turbidity, odour, disinfection process, failure of controls, etc.) the main must be swabbed and retested prior to requesting a follow-up disinfection.



Figure 1 Pipes capped overnight in trench



Figure 2 Fittings capped overnight in trench



Figure 3 Pipes stored without protective caps



Figure 4 Pipes and fittings stored with protective caps

3.2 Option 2 – Capping of pipes and fittings, swabbing

Note: Steps 1-8 remain the same as Option 1. Swabbing directions are italicised.

Table 2 - Option 2

Task no.	Work instruction details	Responsibility
1	All pipes shall be cleaned/capped from the manufacturer or supplier's premises before being received onsite (discussions with WSAA, PIPA and the suppliers are ongoing to confirm capping for larger mains). If pipes are delivered without caps then all pipes should be inspected and cleaned as outlined in step 5 and 6 in this document before installation.	Supplier/ Constructor
2	During and after pipelaying operations , the contractor shall supply and use caps to seal all open ends of pipes, fittings, and valves to prevent contamination . For mains without caps alternative seals may be used providing the seal is clean, non-porous, and drinking water safe. These seals shall be completely removed prior to commissioning, and all caps/seals must be accounted for prior to commissioning. Soft sponges shall not be used to seal pipes, valves or other fittings.	Constructor
3	At the end of each day pipes and fittings in excavations shall be sealed using caps to prevent water or contaminants entering the pipe. When recommencing works any water is to be removed from the trench prior to the removal of caps.	Constructor
4	Caps/seals shall remain in place during boring to prevent contamination.	Constructor
5	Each pipe shall be visually inspected for contaminants prior to laying. Wipe and remove any material prior to installation (Pipe Sanitiser Solution).	Constructor
6	All main taps, fittings and pipe connections shall be sprayed with 1% sodium hypochlorite solution -(Pipe Sanitiser Solution).	Constructor
7	Remove 'coupons' from hole saws after each drill. Speed bores shall not be used on any water main for any purpose as debris clogs services, valves and hydrants.	Constructor
8	In preparation for flushing and disinfection, each end of laid pipe shall have flushing bends installed. Larger mains to be tapered down to accommodate flushing bends (currently available up to 150mm) or temporary tees installed at the ends of the main. Where flushing bends are attached to blank flanges, the flushing bend should be positioned at the bottom of the flange to facilitate flushing of sediment.	Constructor
9	<i>In preparation for swabbing, controls must be developed for swab discharge. Not using a swab catcher may present a WHS risk, and all WHS controls shall be in place before proceeding.</i>	Constructor
10	<i>Keep swabs clean and stored in plastic bags until immediately prior to insertion. Swabs shall only be used once for long lengths of main and shall then be disposed of appropriately.</i>	Constructor
11	<i>Ensure swab catcher is kept clean and stored appropriately.</i>	Constructor
12	<i>Hydrant box & standpipes should be clean and free of water and debris before attaching standpipe.</i>	Constructor
13	<i>Spray standpipe ends using 1% sodium hypochlorite solution prior to installation of standpipe for swabbing.</i>	Constructor
14	<i>When attaching swab catcher to hydrant tee, spray hydrant tee and swab catcher with 1% sodium hypochlorite solution immediately prior to attachment.</i>	Constructor
15	<i>Immerse swab in a stainless-steel bucket filled with 1% sodium hypochlorite solution immediately prior to the swabbing operation. Ensure the entire surface of the swab is immersed.</i>	Constructor

Task no.	Work instruction details	Responsibility
16	Insert swab using a clean plunger that has also been sprayed with 1% sodium hypochlorite solution.	Constructor
17	Operate the controlling hydrant to propel the swab along the main at a velocity of between 0.5-1 metre/second.	Constructor
18	Control discharge water away from the trench into a surface drain following the approved environmental site management plan/REF.	Constructor
19	Upon removal of the swab, inspect swab and ensure it is intact. If swab is damaged or broken, ensure no remnants of swab remain in the water main. Flush main for a minimum 15 minutes or until clear. If water is not clear within 30 minutes check feedwater. If feedwater is not clear contact Sydney Water staff. If feedwater is clear repeat swabbing procedure with a new swab as many times as necessary until the water exiting the new main is clear.	Constructor
20	Record the number of swabs (using ITP) as they leave the main to ensure that none are left in the main. In the event of a swab failing to emerge from the main, the swab shall be located and removed together with any obstruction; if removing the swab requires cutting of pipes, the pipe shall be flushed again until clear.	Constructor
21	A clarity and odour test shall be undertaken by a Sydney Water listed Field Tester.	Constructor/ Sydney Water listed Field Tester
22	Close the controlling hydrant. Flushing bends will remain in place for disinfection of the new main.	Constructor
23	Hydrostatic (pressure) testing shall be undertaken by a Sydney Water listed Field Tester.	Constructor/ Sydney Water listed Field Tester
24	If acceptance criteria are met the main is ready for disinfection.	

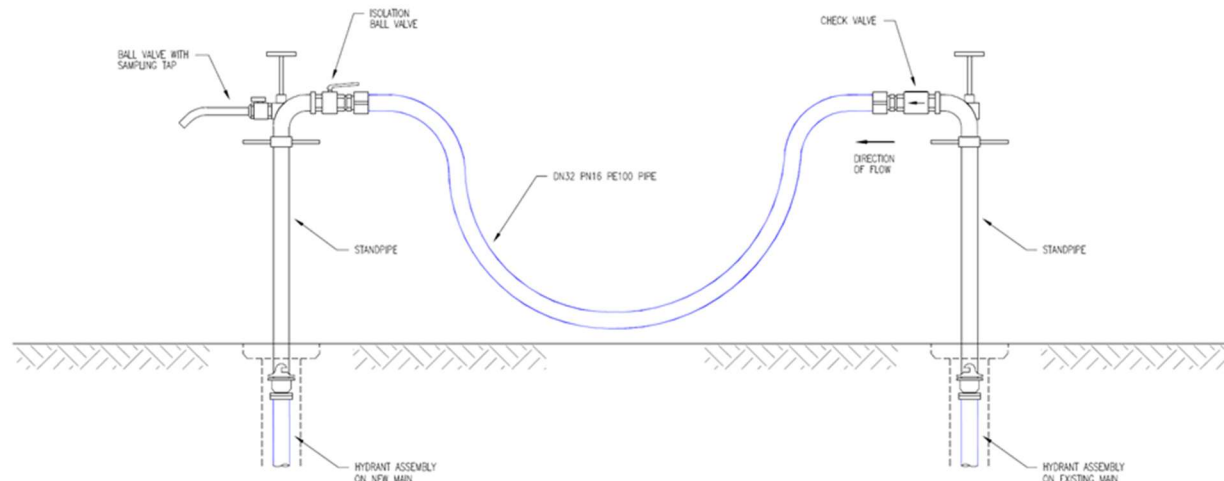


Figure 5 Swab equipment assembly



Figure 6 Discharged water & swab controlled



Figure 7 Discharged water & swab uncontrolled

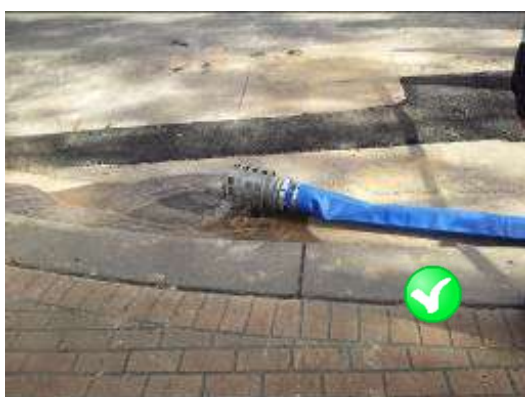


Figure 8 Discharged water directed away from trench



Figure 9 Discharged water into trench

4. Testing

After flushing, a sample must be collected for turbidity or clarity testing (dependent on which option was selected). The hydrant box must be clean and free of water and debris before attaching the standpipe to minimise the risk of sample contamination. A stainless-steel tap connected to the auxiliary port of the standpipe should be used for sample collection (Figure 10 and 11).



Figure 10 Standpipe with sampling tap



Figure 11 Collect sample in clean glass jar or turbidity vial

4.1 Turbidity/clarity testing

Clarity or turbidity can be defined as the cloudiness caused by fine, suspended matter like clay or silt in the water. Elevated turbidity can be detected by customers and can cause the disinfection process to fail. These particles can also affect public health by shielding or protecting bacteria from the effects of chlorine, ozone and other disinfectants.

Two different methods for assessing the cleanliness of the water are outlined below. If Option 1 was selected, turbidity must be used. If Option 2 was selected, either clarity or turbidity is acceptable.

4.1.1 Turbidity testing

Turbidity testing is a quantitative test conducted using a turbidity meter (Figure 12). A turbidity meter typically returns a result in NTU or FNU.

After flushing, a turbidity test can be carried out by a trained Sydney Water listed Field Tester with the results recorded in the contractor's ITP. This shall be done for all pipe sizes.



Figure 12 HACH Turbidity Meter

Procedure for HACH turbidity meter

- Ensure meter is calibrated in accordance with manufacturer's standards
- Collect water sample in vial provided with test kit
- Ensure outside of vial is clean and free of any moisture by wiping the outside with a lint free tissue.
- Insert vial into meter and press read.
- The turbidity level of the water will be displayed on the screen.
- Record result. Follow manufacturer's instructions for other types of meters.

Turbidity meter manufacturer's instructions shall be followed when conducting turbidity tests, and the turbidity meter shall be calibrated according to manufacturer's requirements. Calibration records shall be kept by the Sydney Water listed Field Tester.

Disinfection of the new main cannot be requested until turbidity testing confirms a value of ≤ 2 NTU/FNU.

4.1.2 Turbidity troubleshooting

The following issues may lead to inaccurate turbidity results:

- Dirty glass vial or turbidity meter lens
- Scratched glass vial or turbidity meter lens
- Moisture on glass vial or turbidity meter lens
- Low battery on turbidity meter
- Incorrect positioning of turbidity meter (they must be kept flat and still)
- Air bubbles in sample

Note turbidity meters are generally very accurate and high turbidity results are usually a result of high turbidity water samples.

4.1.3 Clarity testing

Clarity testing can be used to estimate turbidity providing the main has been cleaned in accordance with Option 2. Clarity testing is a qualitative test rather than quantitative and is subjective. It estimates the clarity of the water based on sight.

After flushing, a clarity test may be carried out by a competent sampling person, and the result recorded in the contractor's ITP. This is to be done for all pipe sizes.



Figure 13 Check sample for clarity against a white background

To perform a clarity test, collect a water sample in a clean glass jar and hold it up against a white background, preferably in a well-lit environment (Figure 13).

Descriptors that may be used to describe the clarity include clear, cloudy, milky, turbid, opaque. Colour descriptors can be useful for determining the cause of clarity issues, and commonly encountered colours include milky, brown, black, yellow, orange, blue, green, colourless.

Disinfection cannot be requested until clarity samples return a result of "Clear", which also implies the water is colourless.

4.1.4 Odour testing

Odour is an aesthetic characteristic of the water that can be detected by customers. Odour testing is a simple, qualitative, subjective test that shall be undertaken in the field before disinfection is requested.

To perform an odour test, collect a sample in a clean, clear glass jar and place close to nose. Wave your hand over the jar to move the air toward your nose (Figure 14). This method is used as a safety precaution in the event the sample has been contaminated, to avoid inhalation of toxic substances.



Figure 14 Check for odour

Odour is rated on a scale of 1 to 5 (refer to Table 3 Odour descriptors). If odour is not acceptable (rating 4 or 5) describe the odour, record observations in ITP, and recommence flushing of main.

Disinfection of the new main cannot be requested until odour is acceptable. Note: non-smokers are preferred odour-testers as smoking severely impacts on olfactory capability.

Table 3 - Odour descriptors

Score	Description
1	Water has excellent/no detectable odour, and I would readily use it
2	Water has an acceptable odour, and I would use it
3	Water has some odour, and I would use it
4	Water has a bad odour, and I would not use it
5	Water is undrinkable and offensive

5. Disinfection

Sydney Water disinfects all new mains and determines the type of disinfectant (ozone or chlorine) based on the size and length of the new main. The method of disinfection is often determined during the design review for the FIFM impact assessment.

Requests for disinfection will be submitted to Sydney Water via SWConnect a minimum of ten working days prior to proposed disinfection date.

5.1 High-risk situations

Where suspected contamination has occurred leading to an unacceptable high-risk situation (for example entry of vermin, presence of faecal matter, presence of chemicals), bacteriological and potentially other types of samples (depending on the type of contamination) must be collected after the main has been disinfected. The **main shall not be connected until samples meet the acceptance criteria** and show no risk to public health.

5.2 Main cleanliness

In addition to requirements laid out in this document, **all efforts shall be made to keep new mains clean** during all stages of construction, including transport, storage, and laying. This minimises the risk to public health, the water network, and reputational damage from dirty water events.

Main cleanliness is a key factor in successful disinfection; dirty mains are likely to fail disinfection processes and require corrective action to successfully disinfect. This costs time and money and is not optimal for Sydney Water or constructors/developers.

5.3 Pre disinfection water quality requirements

Avoid leaving water in the **new main for extended periods** (before and after disinfection). It is recommended that the water main is emptied after testing with the intention to refill just prior to disinfection.

Individual jobs will be assessed for the risk of high pH levels prior to disinfection. Samples may be taken prior to disinfection to confirm the pH level of the water within the main. The project owner is responsible for activities associated with the treatment of high pH. Refer to your project specific REF for site specific discharge protocols).

If a water main is not connected to the water network within a satisfactory time period, the main will be reassessed and may require further treatment and testing prior to any connection approvals.

6. Materials

6.1 1% Sodium Hypochlorite solution

When using 1% Sodium Hypochlorite solution ensure all safety precautions are followed, including:

- Obtain & read Safety Data Sheet. A copy of this should be kept with the product.
- Read and understand the safe handling, use, and first aid precautions.
- Use the recommended PPE.
- Use recommended clean-up materials if applicable and ensure waste is disposed of appropriately.
- Ensure solution is 1% sodium hypochlorite only – solutions with other chemicals such as stabilisers or cyanates shall not be used.

Pipe Sanitiser Solution

Pipe Sanitiser Solution is available from Klorman Industries

12 - 14 Amour St. Milperra, NSW, 2114

Phone: 02 9773 0934

www.klorman-industries.com



6.2 Swabs

Table 4 - Swab sizes

Maximum internal pipe diameter (mm)	Swab diameter (mm)	Swab length (mm)	Maximum length of swab discharge control unit (mm)
100	130-150	200-250	Not required
150	200-225	300-350	Not required
200	250-300	350-400	Not required
225	300-340	400-450	1500
250	350-375	425-500	1600
300	400-450	450-600	1600
400	500-600	500-800	1800
450	550-675	600-900	2000
600	750-900	900-1200	2600
850	1000-1275	1100-1700	3000

6.3 Standpipe fittings, hoses and temporary services

All materials in contact with drinking water supplied to customers must comply to AS/NZS4020:2018 and be food grade products. If water is being supplied via a temporary connection, clarity and, taste and odour testing must be conducted at the customers tap and the test results recorded. This is to prevent any water quality problems that may be a product of any part of the connection and guarantee the customer a gets good quality water supply. Fittings and hoses are to be kept clean prior to and during installation.

6.4 Backflow prevention measures

The customer's water meter will be connected to the household supply as part of the temporary service connection during main renewals. The temporary service must be attached to some form of backflow prevention either through the meter which has backflow prevention or if the meter is bypassed then another backflow prevention device must be installed inline. This is a fundamental barrier to protect public health and the drinking water network from any potential backflow from a customer's property.

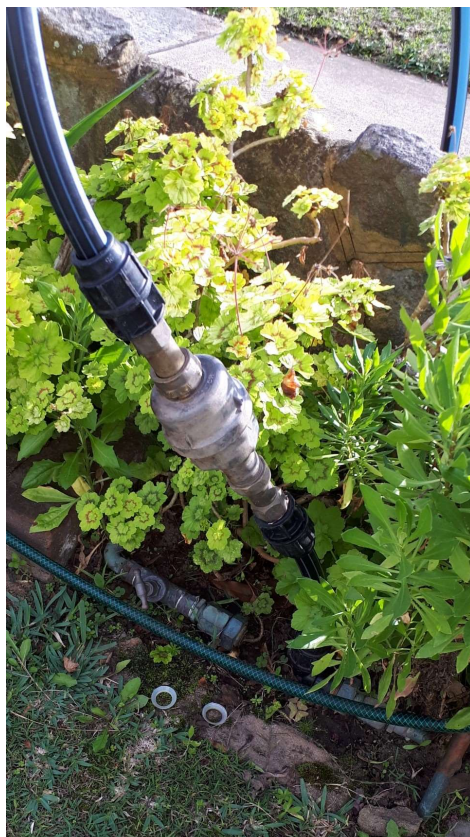


Figure 15 Backflow prevention on a temporary service

7. Definitions

Term	Definition
Swabbing/pigging	Mechanical method of cleaning mains using a foam swab/pig
1% Sodium Hypochlorite solution	Sanitiser solution made up of 1% sodium hypochlorite. Must not contain stabilisers, cyanates, or other additives
ITP	Inspection & Test Plan
Turbidity	Cloudiness in water caused by fine suspend matter
FIFM	Flow Isolation &/or Flow Management
SDS/MSDS	Safety Data Sheet/Material Safety Data Sheet
PPE	Personal Protective Equipment
WSAA	Water Services Association of Australia
PIPA	Plastics Industry Pipe Association of Australia

8. Context

8.1 Accountabilities

Position	Accountabilities
Manager, Asset Inspection Services	Review procedure and ensure requirements are implemented
Program Coordination/ Operational Services Team Leader	
Manager Communication and Funding Framework	
Project Managers, Delivery Management	
Relevant contractors and providers such as Water Servicing Coordinators and Sydney Water listed constructors	Ensure this procedure is followed and provide auditable evidence

8.2 Training and competencies

Position	Training or competency
(Delivery Management)	Organise training for the Delivery Management contractors
Program Coordination/ Operational Services Team Leader	Ensure staff are trained in this procedure
Water Services Coordinator	Must be trained in this procedure and organise awareness training for constructors involved in pipe laying work
Water main constructors	All on site staff to have awareness training on this procedure

8.3 References

Document type	Title
Policies and procedures	Water Supply Code of Australia (WSA Code 03-2011-3.1) – Sydney Water Edition 2014 AS/NZS4020:2018 Testing of products for use in contact with drinking water

8.4 Attachments

Attachment	Title
1	Appendix 1 Controls used for pipe laying
2	Appendix 2 pH in water mains

9. Ownership

Role	Title
Group	Water & Environment Services/Systems Water Quality team
Owner	Andrew Peters – Systems Water Quality Manager
Author	Kevin Withers – Water Quality Scientist

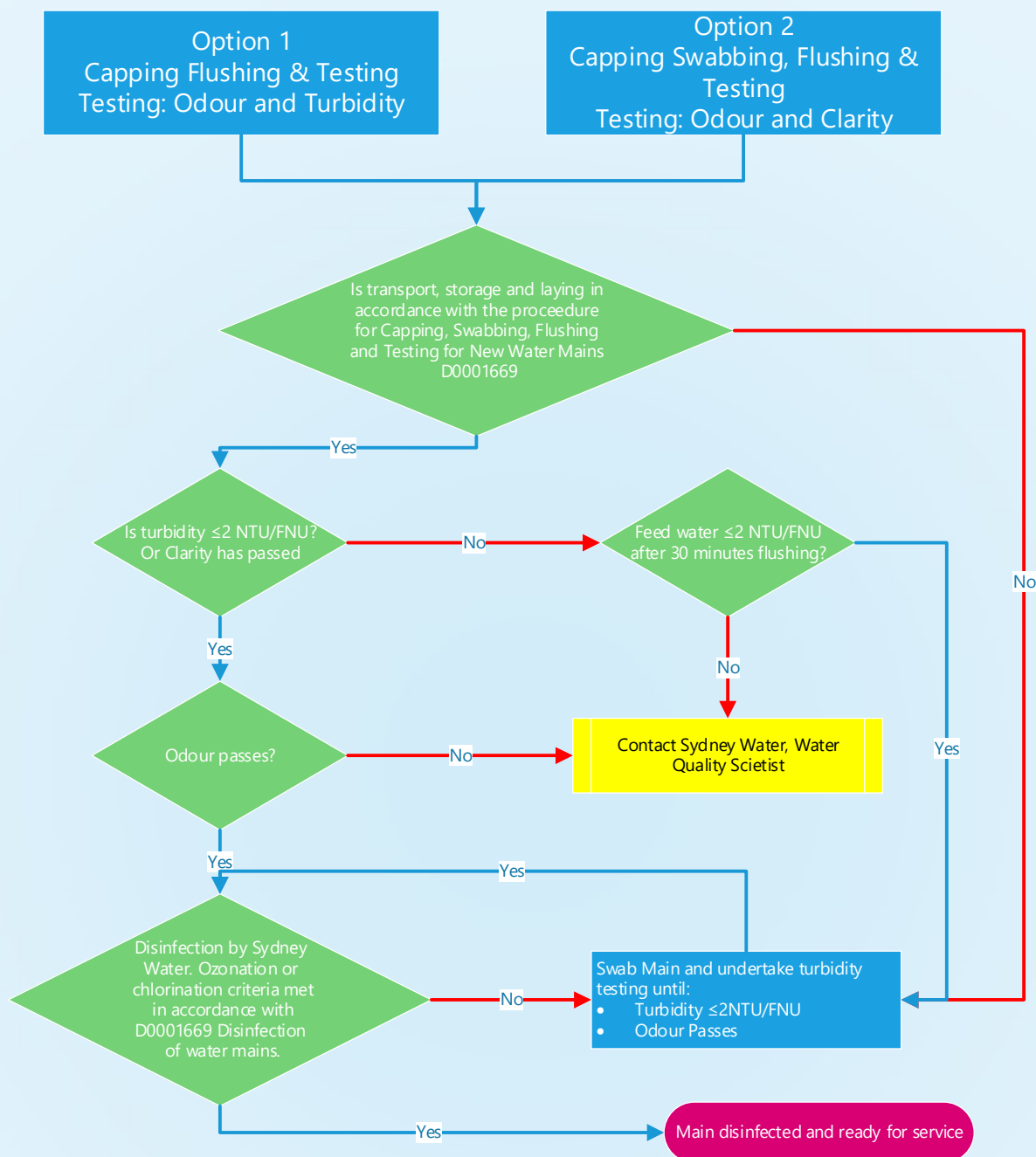
9.1 Change History

Version	Issue Date	Approved by	Brief description of change and consultation
3	14/01/2025	Corinna Doolan	New version in a new template

10. Appendix

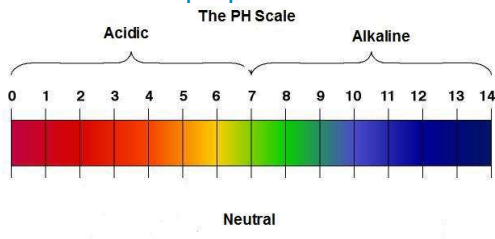
Appendix 1 - Controls used for pipe laying

All new mains laid must be in accordance with either Option 1 or Option 2.



Appendix 2 - pH in water mains

This fact sheet provides information to project managers about pH requirements of the water within a water main in preparation for the successful and timely disinfection of a new water main.



What is pH in drinking water?

The pH level of drinking water reflects how acidic or basic (alkaline) it is. pH is measured on a scale that runs from 0 to 14. A pH of 7 is neutral, meaning there is a balance between acid and base. pH's less than 7 are acidic and pH's greater than 7 are alkaline.

When discharging water, the pH should be between 6.5 and 8.5 pH units, unless specified differently by a project specific review of environmental factors (REF).

What causes high pH in water mains?

Water with low turnover that is in contact for prolonged periods of time with cement lined mains can have elevated pH above 8.5. This is caused by lime leaching from the cement lining. This can occur within a few days.

Why is pH important?

pH levels outside of 6.5 - 8.5 may impact aquatic ecosystems and could result in material harm to live aquatic organisms such as fish. pH above these levels will impact on the effectiveness of disinfection and compromise public health.

Treatment of high pH water

Ways to prevent/treat high pH could include:

1. Minimise the time that the water is in contact with a cement lined water main.
2. pH correction using hydrochloric acid.
3. pH correction using carbon dioxide (CO₂).

Responsibilities

The project owner is responsible for activities associated with the treatment of high pH. Sydney Water is only responsible for the treatment of super chlorinated water during disinfection. However, Sydney Water can provide advice on the appropriate methodology for treating high pH in water mains.

Sydney Water advice

- Avoid leaving water in the new main for extended periods of time (before and after disinfection). It is recommended that the water main is emptied after testing with the intention to refill just prior to disinfection.
- Refer to your project specific REF for site specific discharge protocols.

Reference material

- WSA 03-2011-3.1 Sydney Water 2014 Edition.
- Protection of the Environment Operations Act 1997 (POEO Act)